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A RAND NOTE

Representing Operational Strategies and Command-Control in the RAND Strategy Assessment System (RSAS)

Paul K. Davis, Robert D. Howe

October 1990

RAND

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Models and games used for defense analysis tend to focus on the capability of the forces involved--emphasizing the interaction of weapons systems over operational issues like strategy and command-control. This Note describes RAND's approach in developing and applying a new generation of analytic tools to remedy this problem--the RAND Strategy Assessment System (RSAS). The RSAS includes military-command-level decision models, called analytic war plans (AWPs), to represent decisionmaking by theater commanders. Some of the dimensions of operational strategy include: For the attacker, number and choice of main sectors (initially and after seeing defensive reactions), reserve fraction, force ratio to be maintained on non-main sectors, and tradeoffs between achieving surprise and preparing one's own forces. For the defender, strategy dimensions include the basic defensive and command-control posture, operational strategy, reserve fraction, and the proactiveness of reserve employment.

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PREFACE

This Note was originally prepared for presentations at a minisymposium on operational art sponsored by the Military Operations Research Society, held at the National Defense University on March 6–9, 1990, and at the Symposium on C^3 in Combat Models and Games, sponsored by the NATO Defense Research Group and held June 6–7, 1990, at the NATO Headquarters. Although the Note itself was developed independently by the authors, it draws upon a considerable body of research and analysis sponsored by the Director of Net Assessment in the Office of the Secretary of Defense.

Work was conducted in the RAND Strategy Assessment Center (RSAC), which is part of RAND's National Defense Research Institute (NDRI), a federally funded research and development center sponsored by the Office of the Secretary of Defense and the Joint Chiefs of Staff.

SUMMARY

Models and games used for defense analysis tend to focus on the capability of the forces involved—representing the interaction of weapons systems in great detail while giving short shrift to such operational issues as strategy and command-control. However, historical experience and analysis both indicate that how forces are *employed* usually dominates other factors in determining the outcome of battles, campaigns, and wars—at least within broad limits. This Note describes the approach taken by RAND in developing and applying a new generation of analytic constructs and tools to remedy the problem, which is reflected in an integrated framework called the RAND Strategy Assessment System (RSAS).

The RSAS includes military-command-level decision models, called Analytic War Plans (AWPs), to represent decisionmaking by theater commanders (and in some cases subordinate operational commanders). These models operate on the basis of explicit logical or algorithmic rules. The decisions may be as simple as seeking to enforce a time-phased force deployment list amidst such complications as selective delays, or as complex as sophisticated, highly conditional, and adaptive responses to the situation and enemy action (e.g., deciding where and when to develop prepared defenses as a function of the threat and time thought to be available).

The AWPs are written in the high-level RAND-ABEL® programming language, which is relatively easy for analysts to read and modify. Thus, analysts can readily vary the decision criteria and the actions specified by decisions.

Much of the work accomplished with AWPs dealt with the Europe's pre-CFE Central Region, and we draw on that work here for examples. New work, however, is concerned with assessing possible post-CFE European force postures that could include large-scale reductions, and with alternative strategies for combat in the Persian Gulf and elsewhere. We merely touch on some of this new work here.

As discussed in this Note, some of the principal dimensions of operational strategy include, for the attacker: (a) number and choice of main sectors (initially and after seeing defensive reactions), (b) reserve fraction, (c) force ratio to be maintained on non-main sectors, and (d) tradeoffs between achieving surprise and preparing one's own forces. For the defender, some of the dimensions of strategy include: (a) the basic defensive and command-control posture (e.g., layer cake), (b) operational strategy (e.g., forward defense or alternatives), (c) reserve fraction, and (d) the proactiveness of reserve employment.

In some of our recent work, the focus has been on testing the impact of alternative NATO postures and strategies in a deep-reductions regime. The results indicate rather dramatically how critical these matters can be: although one might expect defense to be easy under conditions of parity or near parity, it is quite possible for the defender to lose if he doesn't employ his forces well. The use of explicit analytic war plans improves the quality and efficiency of studies on these matters, and records the lessons learned so that they can be remembered in subsequent work.

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I. BACKGROUND

ON THE DOMINATING INFLUENCE OF THE STRATEGY VARIABLE

In previous work the authors have written about the importance of *multiscenario analysis,* by which is meant examining a broad range of cases in considering such issues as the military balance, possible improvement measures, and arms control (Davis, 1988a). It is useful to think of the variables defining cases as lying along four dimensions: (1) political-military scenario, (2) strategy and tactics, (3) force structure, and (4) technical factors. Although the vast majority of defense analysis dwells on issues of force structure (e.g., the relative incremental benefits of buying weapon system A versus weapon system B), one gets a very different sense of priorities when looking at historical experience. Consider, for example:

- The role of operational *surprise* and combined-arms operations in the fall of France in 1940, Operation Barbarossa, the Japanese Pacific campaign against the United States that began with Pearl Harbor, the Normandy invasion, the Soviet Manchurian operation against the Japanese late in WW II, and McArthur's amphibious landing at Inchon in the Korean war.[1]

- The role of *operational maneuver* by Lee and Jackson in providing the Confederacy its early campaign victories in the U.S. Civil War (and later the maneuver of Grant and Sherman in determining the ultimate outcome of that war).

- The role of *operational-strategic maneuver* in successful Soviet Eastern Front operations in WW II[2] and the role of *political-level constraints* (Hitler's operational and strategic-level decisions) in making the Soviet breakthrough operations feasible.

- The role of *detailed operational planning and training*, coupled with operational surprise, in the successful Egyptian Suez-crossing operation against Israel in 1973.

- The role of *tactical and operational-level maneuver* in consistently giving the Israelis a 2:1 superiority in effectiveness against Arab armies.

- The spectacular role of *command and control* in dominating results of the air war between Israel and Lebanon.

[1]For discussion of the role surprise has played in military operations see Knorr and Morgan (1983) and Betts (1982). Davis (1989) describes ways to use arms control to avoid surprise.

[2]See Dupuy (1987) for considerable historical discussion of these matters.

In a similar vein, those familiar with theater-level balance assessments are sensitively aware of how dominant the role of political-military scenario can be, and that political-military scenario should be thought of not as an exogenous variable but, to a large extent, as a consequence of the attacker's war strategy. As examples of how pol-mil strategy has mattered in Europe's Central Region (using examples from Davis (1988a and 1989) that predate the fundamental changes that occurred in Europe during 1989):

- NATO has had *qualitatively* different challenges in preparing for Central Region conflicts involving minimal, short, medium, and long mobilizations by NATO. At the same time, a Pact planner contemplating associated strategies would have difficult tradeoffs in terms of balancing attacking before NATO was prepared against attacking with fewer of his own forces prepared.
- The most serious problems for NATO in the event of a Central Region conflict in recent years would probably have been: (a) maldeployment, (b) rigidity of command-control, and (c) likely raggedness of mobilization—not force levels or the quality of those forces.

In thinking about such issues and the limited attention they have received, some of us have been struck by the aptness of two claims that seem to characterize worrisome differences between U.S. and Soviet planning styles:

- NATO plays checkers; the Soviets play chess.
- In NATO planning, command and control is a subordinate and "technical" issue; in Soviet planning, command and control is part of the essence.

Although the threat of a monolithic Pact attack on the Central Region no longer seems credible, the appropriateness of raising the visibility of the strategy variable remains as high as ever as we begin to contemplate the military challenges of future decades. Indeed, as we think about a range of nonstandard "contingencies" worldwide, we should be careful not to conceive and evaluate strategies as though we contemplated a large-scale armored slugfest as envisioned in pure attrition models. Had the British envisioned attrition warfare, the Falkland Islands campaign would never have been undertaken.

THE NONREPRESENTATION OF STRATEGY IN USUAL ANALYSIS

In traditional military models the concept of operational strategy is *implicit* rather than explicit. Even when the word "strategy" appears in such models, it usually applies to something more narrow and technical than what a military strategist or historian would

have in mind.[3] Further, in typical studies the employment of forces in a simulated campaign is determined in advance as input data—i.e., force employment is *scripted,* even though competent real-world commanders would adapt their strategy as the campaign developed.[4] Analysts have sought to mitigate this problem by iteratively changing the data base until the force employment throughout the simulated *baseline* campaign appears reasonable, but even this procedure has a fatal flaw when excursions are then run to compare the relative value of alternative force modernization packages, arms control limitations, etc. In such comparisons strategy is typically held constant, even though in the real world it would adapt to the new capabilities. This problem is real and serious, and it has led to misleading conclusions in a number of studies.[5] Comparably serious has been the longstanding tendency in studies, and even in operations planning, to avoid fully facing up to the complications of joint and combined-arms planning in a politically constrained environment.

BROAD GOALS FOR DOING BETTER

This concern for the strategy variable was a major factor in early design of what has become the RAND Strategy Assessment System (RSAS). In particular, we sought:

- To break the mold of thinking in terms of fixed scenarios.
- To compel systematic thinking about joint and combined-arms operations.
- To compel explicitly treating "special issues" such as operational maneuver groups, chemical attacks, strategically significant use of airborne and special-operations forces, and even amphibious operations.

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[3] In studies of conventional warfare, "strategy" typically corresponds to a stereotyped employment of forces according to doctrine, official planning scenarios, or, in the case of the opponent, observed exercise practice. Such strategies are unencumbered by the problems real-world commanders would have with allies, political constraints, and deception.

[4] Some of the theater-level combat models have simple decision rules adaptively allocating reserves among sectors, but such models are working on the margin rather than adapting at the operational or theater level. For example, a model may follow the rule of reinforcing success for the attacker and reinforcing failure for the defender, establishing a rate at which divisions can be committed from the reserves in accordance with this rule. However, such models do not allow for more basic changes of strategy, such as a large-scale fallback, counteroffensives, and restructuring of corps boundaries. Such issues do arise in certain forms of human gaming (e.g., with the IDAHEX model, which emphasizes maneuver), but have not until recently been highlighted in simulations.

[5] In one egregious example a study concluded that the "Gorbachev unilateral reductions" would greatly reduce the threat to the Central Region. Our own analysis concluded that they would greatly reduce the short-mobilization threat but have relatively little impact on longer-mobilization cases, since there were logical ways for the Soviets to restructure their operational strategy to compensate for the dislocations and "holes" caused by the reductions, which will not be particularly large in an aggregated sense.

- To provide a mechanism for defining and discussing command-control relationships from the national command authority down to the level of theater commanders or even subordinate commanders.

- To sharpen thinking about operational strategy in the context of a malevolent opponent with his own strategy (e.g., to provide an automated Red commander against whom Blue officers and analysts could try out their concepts).

- To encourage a building-block approach in which adaptive strategies could be fashioned from pieces.

- To bridge the gap between analysts on the one hand and commanders, historians, and strategists on the other.

II. DESIGNING AN APPROACH

EXPLOITING NATURAL HIERARCHIES TO COPE WITH COMPLEXITY

This is not the place to discuss in detail the design or content of the RAND Strategy Assessment System (RSAS) as a whole, but it is useful to provide some background before focusing on the topics of most concern in this Note.

A Hierarchy of Objectives and Strategies

Once one begins to think seriously about how to represent strategy, it becomes important to distinguish explicitly among several levels of strategy, as suggested in Fig. 1.

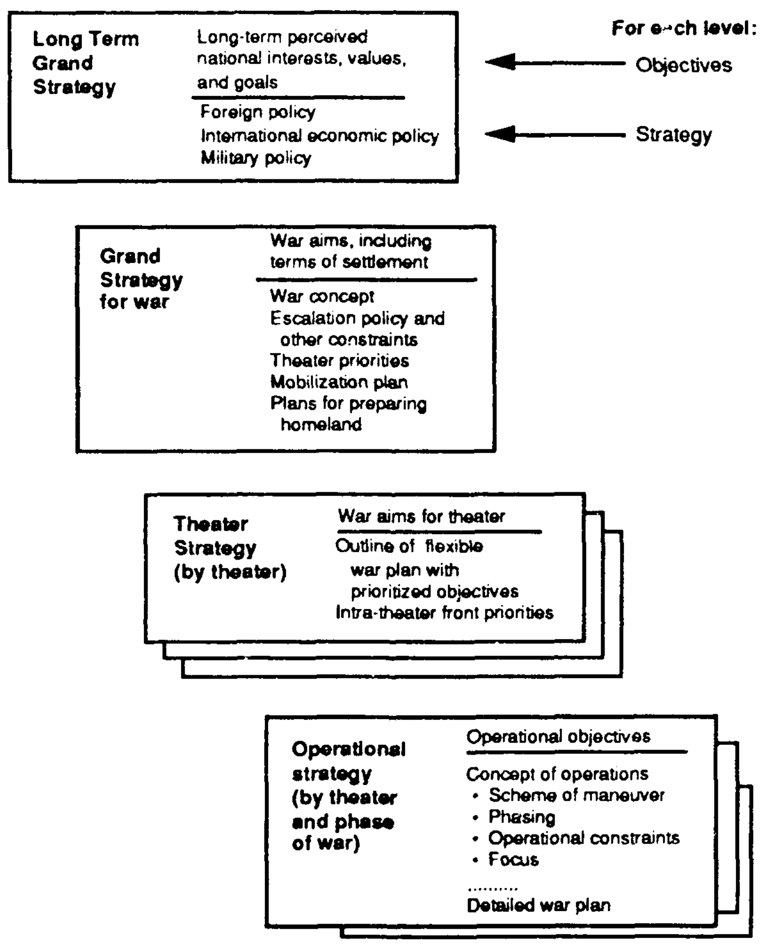

Fig. 1—A hierarchy of objectives and strategies

The RSAS is designed to deal with the second, third, and fourth levels but not long-term grand strategy. This Ncte is concerned primarily with theater strategy and, more specifically, operational strategy and command and control in one campaign of a war in a particular theater. Although the focus is on AFCENT, the principles embodied in the development of the plan for this command apply equally to other commands, although obviously the details of terrain and force employment may vary considerably. When multiple commands are considered it is the function of the higher levels, such as Europe Command and JCS, to coordinate force assignments and missions among the various commands—the same function these command levels serve in the real world.

The RSAS as an Integrated System for Analytic War Gaming

The RSAS is an integrated system for analytic war gaming, by which we mean that it is a system for rigorous and reproducible analysis but also has much of the "feel" of war gaming. Indeed, human gaming and sandtabling are major elements of RSAS-style studies, because they provide insights such as a sense for the "real" variables.

As Fig. 2 illustrates, the RSAS consists of decision models, simulation models, and utility programs (Davis and Hall, 1988). The decision models are often called "agents," while the simulation of combat and other military operations is usually called CAMPAIGN (or Force Agent) (see Bennett, Jones, Bullock, and Davis, 1988). Figure 3 shows how the various models relate to one another (in an aggregated view). The Red, Blue, and Green agents make decisions that produce orders to the military forces, which are then processed by the

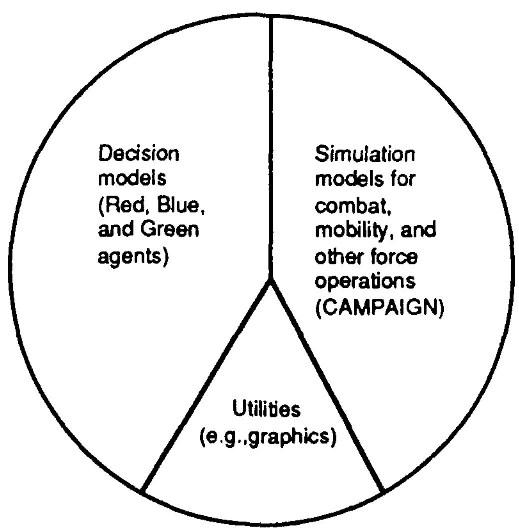

Fig. 2—Decomposition of the RSAS

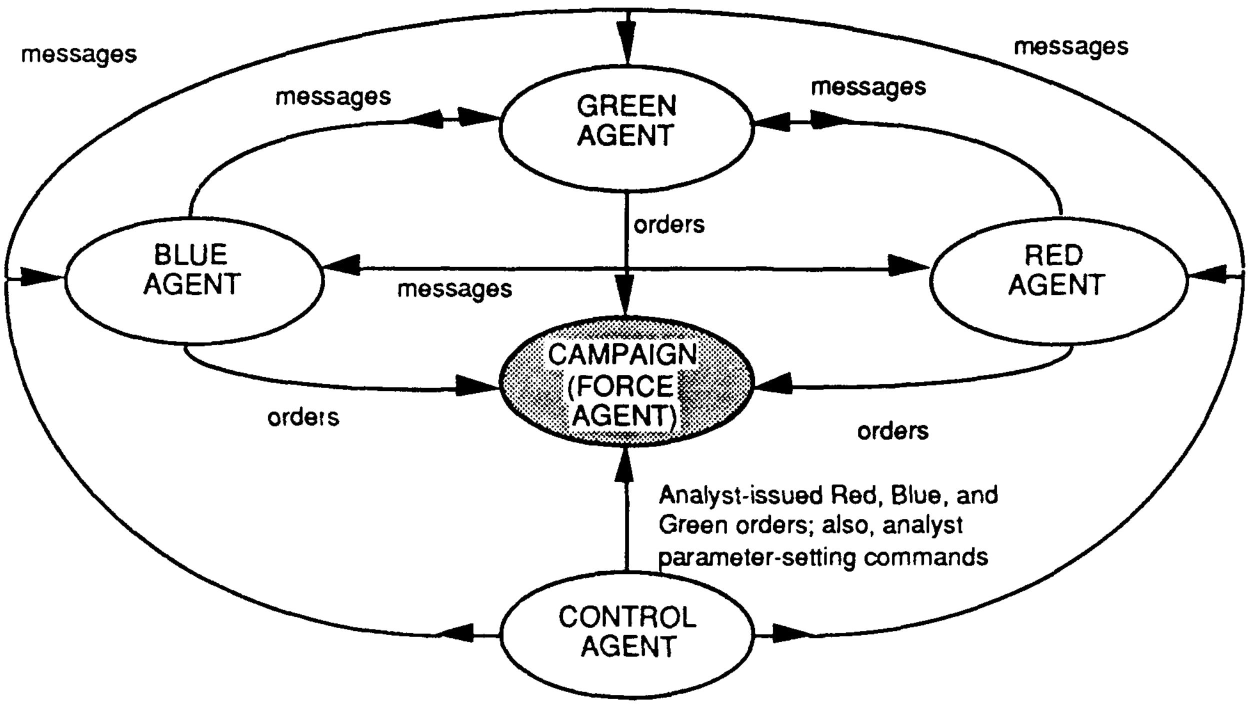

Fig. 3—Data flow among top-level RSAS models

simulation model CAMPAIGN. Control Agent is an analyst-interface mechanism described in more detail elsewhere. As shown in Fig. 4, the Red and Blue agents decompose hierarchically into a political, national-command-level (NCL) model and various military-command-level (MCL) models that correspond approximately to real-world command-control structures. Figure 5 shows the concrete example of this for the military command levels of Blue that are currently represented in the RSAS. The commands and the theaters they cover can be changed *relatively* easily.

This Note is concerned primarily with how theater-level decision models (e.g., AFCENT of Fig. 5) represent operational strategy explicitly and coherently. However, there are many cross-theater issues such as the assignment of forces, allocation of airlift and sealift, phasing of operations by theater, and coordination of alert levels and rules of engagement. All of this must be done in a manner consistent with political-level objectives, strategy, and qualitative guidance.

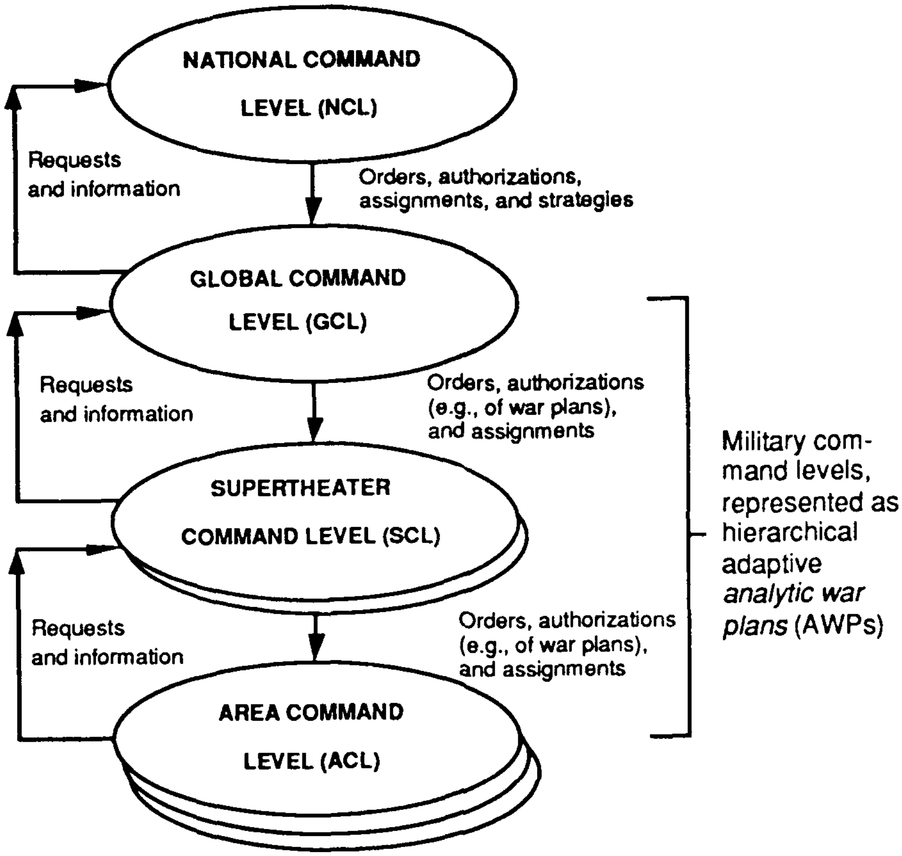

Fig. 4—Hierarchical decomposition of the Red and Blue Agents

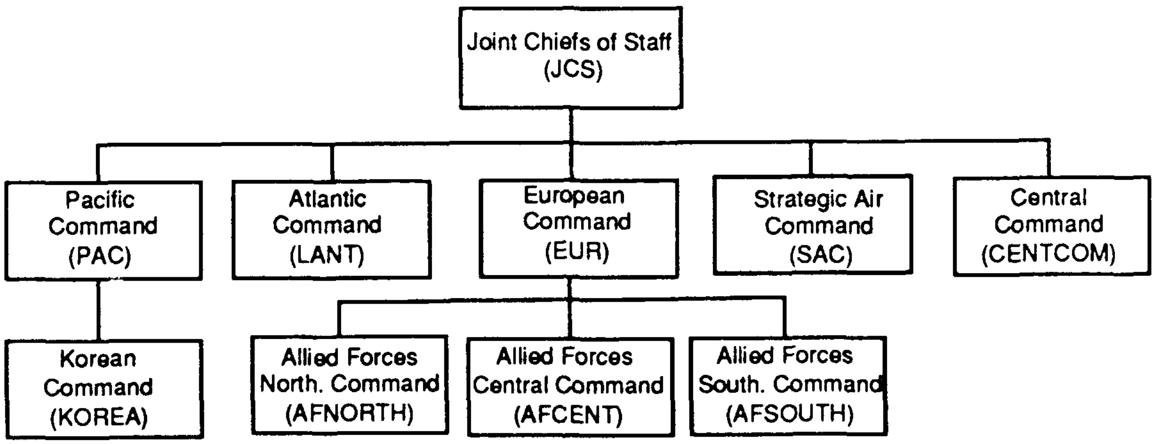

Fig. 5—Illustrative decomposition for Blue of the military command level

MILITARY COMMAND LEVEL MODELS AND ANALYTIC WAR PLANS

Functions

The RSAS represents military commands at the level of theater commands and higher. Ultimately, MCL models must issue the force orders that are the inputs to the CAMPAIGN model's simulation of force operations, including combat. The rationale relating the various force orders is the *plan* embodied in a given MCL model.[1] Indeed, we usually call the MCL models *analytic war plans* (AWPs). It is crucial to emphasize, however, that these are adaptive decision models, not, as in traditional models, mere scripts of orders. Often, RSAS users will begin developing AWPs by building scripts of orders in the traditional way, but more competent users then go on to add adaptive logic representing the changes that real-world military commanders would make in the course of operations.

As Fig. 5 indicates, the Blue JCS model is the superior of the EUR model, which is the superior of the AFCENT model, for example. Figure 6 describes generic inputs and outputs of the various MCL models. The JCS and EUR models have as outputs authorizations to the lower-level models. These correspond approximately to real-world authorizations (e.g., "You are authorized to trade space for time as you deem appropriate."). All of the MCL models may make requests of their superiors (the NCA in the case of the JCS model). Also, all of the MCL models may, in lieu of direct and explicit force orders, set parameters tuning the behavior of lower-level decision models embedded in the CAMPAIGN simulation. For example, the AFCENT decision model specifies parameter values that establish priorities for the defense of different sectors and the maximum length of certain flanks. These parameter values are set consistent with the AFCENT model's theater-level strategy. When CAMPAIGN runs, it will allocate reserves and issue orders about fallbacks based on a mix of algorithms and rules that use these parameters. The MCL models are also responsible for alerting higher-level authorities when certain events occur. These are called "bounds" and range from the opponent's use of nuclear weapons, the suffering of excessive attrition, or the loss of a key ally. Some of this corresponds to real-world reporting from the field and some amounts to a technical mechanism for assuring that the RSAS's higher-level models make decisions at appropriate times.

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[1] See Schwabe and Wilson (1990) for documentation of the RSAS military command level models.

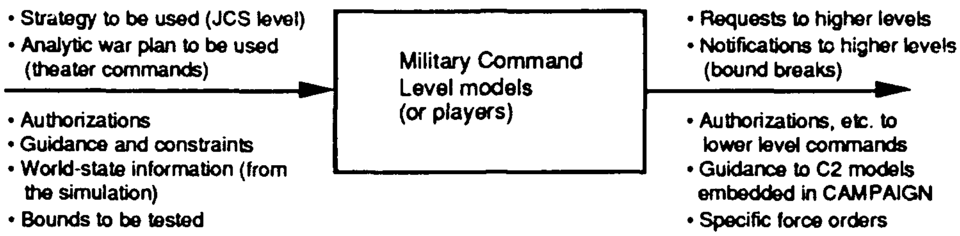

Fig. 6—Inputs and outputs of MCL models (or players)

The inputs used by MCL models include authorizations, world-state information, the bounds that are their responsibilities to watch, higher-level strategy, constraints, and directives. As an example here, a particular model of AFCENT might have the authorization to conduct a fallback defense in some sectors and the authorization to use battlefield nuclear weapons in response to enemy use of nuclear weapons (normally, such authorization would *not* be granted). Depending on such world-state information as its attrition rates and force ratios by sector, the AFCENT model might in fact conduct a fallback (or respond to nuclear use). If so, however, it would be subject to constraints (e.g., a fallback could be no greater than to a specified river line, or any nuclear use could involve no more than a specified number of battlefield weapons). Precisely what constraints and directives exist is determined by users as part of developing the analytic war plans for their particular study.

This is a good time to emphasize that the baseline RSAS analytic war plans provided to users should not be thought of as on-the-shelf reliable models to be used routinely. Instead, they should be thought of as starting points for building study-specific AWPs. The baseline AWPs come, however, with many building-block components that users can draw upon.

User Modes

There is a wide range of user modes available in representing the MCL. These may be considered to be choices in three dimensions: (a) treatment of commands, (b) role of humans, and (c) adaptiveness. Figure 7 illustrates the choices schematically. In one extreme, human players may be used for each command, and they may build simple nonadaptive baseline plans (scripts) to which they stick throughout the war game. At the other extreme, MCL models may be used for all the commands, and the MCL models may be rather highly adaptive. In principle, they could call upon optimizing algorithms, or at least good satisficing rule-based submodels, to help in making the adaptations. For example, the SAC model could

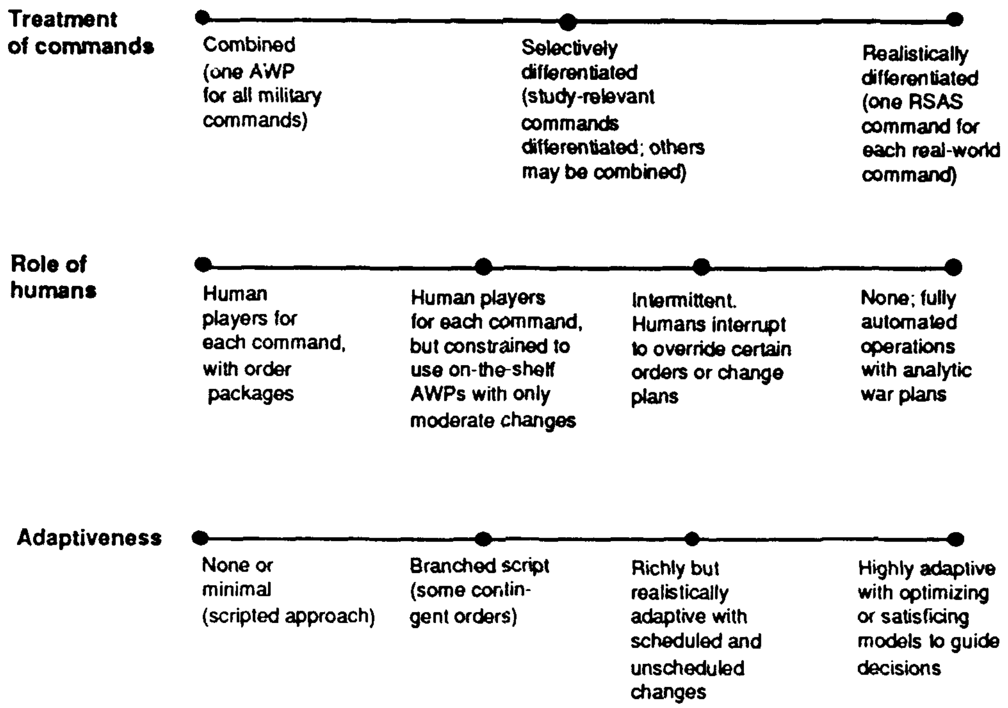

Fig. 7—Dimensionality of user choices for military command level

use a linear program to optimize its targeting of nuclear weapons in a SIOP. To use a current example, the AFCENT analytic war plans set parameters in a CAMPAIGN model that allocates ground-unit reserves to sectors using an operations-research-style method maximizing utility as defined by the weighted sum of several measures of effectiveness, subject to numerous constraints.

Basic Concepts Underlying MCL Models

Structure of Analytic War Plans. As we have already noted, the MCL models are structured as adaptive plans.[2] Thus, they are organized *procedurally*. Figure 8 illustrates

[2] Taking this approach was a nontrivial decision, with some of the project team envisioning instead a type of model that would systematically "search" for the "best" strategy, somewhat as checkers or chess-playing programs do (which in fact are quite different from one another). We chose not to take that approach, because neither the technology nor our intellectual concepts were yet strong enough to make such an approach feasible unless great sacrifices were made in military content. Warfare is an extraordinarily complex phenomenon in which there is little room for "optimizing." The approach of basing MCL decision models on the concept of adaptive plans would allow us to (a) make direct use of the considerable military expertise that already exists, (b) conceive issues in natural terms, and (c) confront the full dimensionality of the problems theater commanders face. The hierarchically modular approach we took in developing plans is consistent with theories of bounded rationality discussed by Simon, Newall, and others.

schematically that a given AWP is hierarchically structured in terms of *phases, moves,* and *order packages* (not shown). Current RSAS AWPs have a phase for deterrence (e.g., for actions during crisis but before hostilities begin), for various phases of combat, and for termination. Within each phase there are a number of moves, which in turn consist of order packages. During a deterrence phase, for example, one might have a limited mobilization move and, later, a full-scale mobilization move. Within each of these moves there would be order packages corresponding to both mobilization and deployments. A Reforger move would consist of numerous force orders directing the deployment of named units to their warfighting positions in Europe. There would be different force-order packages for air forces, ground forces, naval forces, and, perhaps, space assets. Many of these building-block packages would be useful in a variety of different plans, and would therefore be placed in a *library* of functions. In a given war game or simulation, some of these might be altered on the margin or drastically.

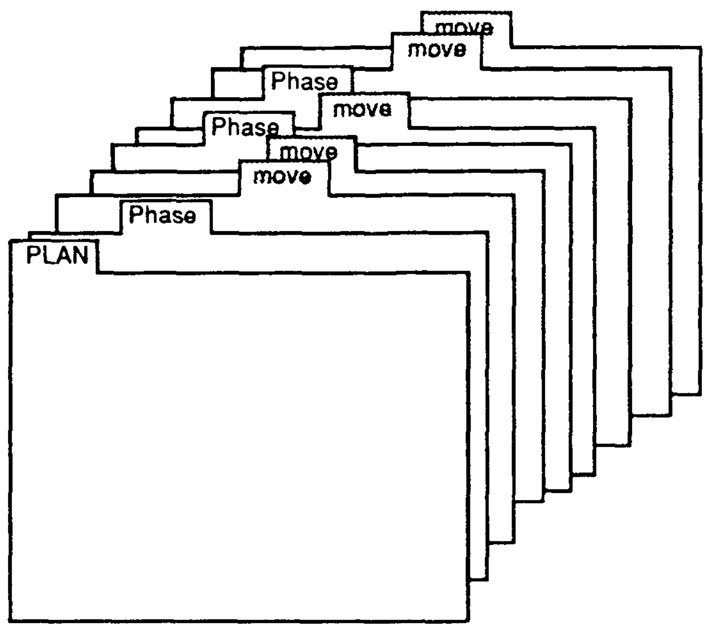

Fig. 8—Structure of AWPs

This systematic structuring of order packages and moves is in itself a valuable contribution to analysis, because it compels users to think in terms of campaigns, building blocks, and the integration of those building blocks in a joint and combined-arms plan. To be sure, we may choose to suppress aspects of the full complexity in a particular study (e.g.,

ignoring the air war altogether when trying to understand the significance for ground combat of large-scale reductions in Europe). However, the integrating structure is there. Further, the structure exists also at the supertheater and global military levels. Thus, the JCS AWPs must deal with issues such as the assignment of forces and strategic mobility assets across theaters, and the EUR AWP (representing SACEUR) must perform similarly within the European theater. The RSAS therefore makes it difficult to sweep under the rug such difficulties as having three or four theater plans that make use of a particular division or air wing.

Figure 9 lists some standard building-block order packages for such problems as conducting various specific fallbacks, mounting counteroffensives, conducting the Reforger deployment, and so on. Many of the packages have subordinate packages dealing in a coordinated way with ground, air, and naval forces. These provide the nitty-gritty details needed by the CAMPAIGN model (e.g., the names, destinations, and priorities for deployment of Reforger forces, or the positions back to which defenses would fall in particular options). The growing library of RSAS AWP building blocks is a basic feature of the system.

US-deploy-to-AFCENT
AFCENT-deploy-Crested-Cap
AFCENT-deploy-Reforger

AFCENT-cover-missing-ally
AFCENT-deploy-returning-ally
AFCENT-move-relieved-forces
AFCENT-support-Austria-move

<River>barrier-order

AFCENT-nuclear-dispersal-order
AFCENT-demonstrative-nuclear-use-move

Determine-axis-values
AFCENT-determine-axis-status
AFECNT-fallback-decision

Fig. 9—Illustrative library functions for AFCENT

Scheduled and Unscheduled Adaptations. Fundamental to the development of military strategy is recognizing that force employment must adapt as a function of what happens in the early phases of action (the result of opponent actions and the imperfectly

predictable effectiveness of combat and maneuver operations, for example). Some adaptations can be recognized and planned for in advance because if they are necessary at all they will be necessary at more or less predictable times. We call these *scheduled adaptations* or *branches*. Figure 10 illustrates schematically how such branches can be represented. The portion of the plan represented is the deterrence phase of an AFCENT plan, that is, the time after an enemy mobilization is detected and before hostilities begin, with some of the possible decisions indicated. The diamonds represent decision points, with the criteria being tested shown to the right of the diamond. The rectangles indicate RAND-ABEL® functions to be

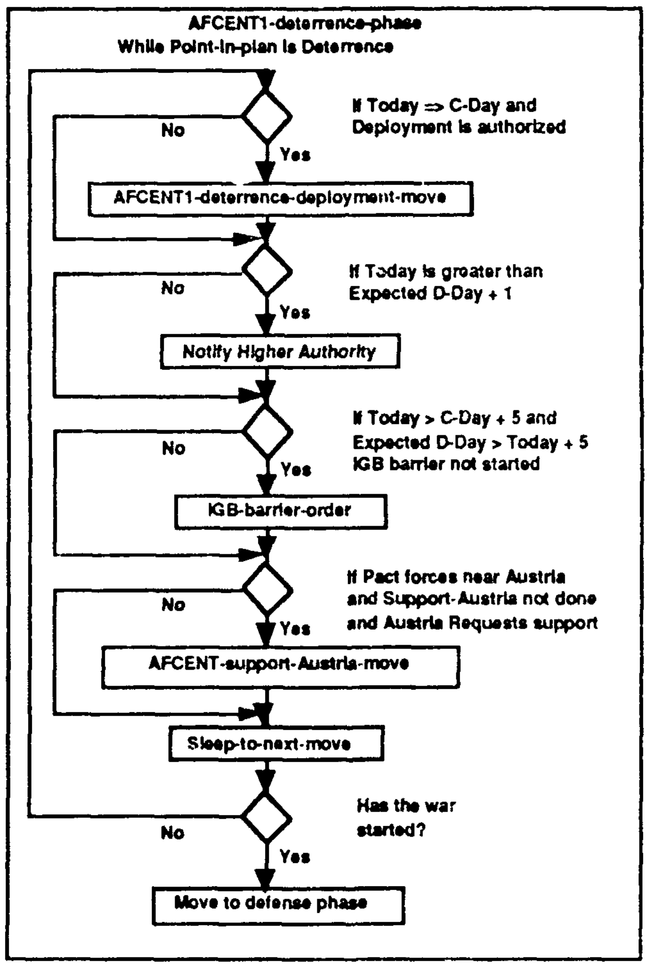

Fig. 10—An illustrative time-phased plan with scheduled adaptations

performed when the decision criteria are met. The function *Sleep-to-next-move* indicates that the AFCENT model ceased to function and turns control back to the main model control function. Either after the elapse of a specified time or the occurrence of a specified event, the

model control reactivates the AFCENT plan to once again test the deci ion criteria. When the AFCENT plan is activated and it determines that combat is occurr ıg, the *Theater conflict level* test, then the plan terminates the deterrence phase and r oves to the defense phase.

Other adaptations can be anticipated in general terms, but cannot realistically be scheduled (although planners sometimes attempt to do so by focusing on stereotyped scenarios), even to the extent of being confident that the adaptations will precede or follow other major operations. We call these *unscheduled adaptations*. As an example of a scheduled adaptation, one might consider a commander planning an invasion. Depending on success in the first phase of operations, as well as on the coalition of forces that forms against him during that phase, he may or may not choose to continue into a second and more ambitious phase. By contrast, consider planning for nuclear use in the European theater. Commanders must be prepared to transition into nuclear operations quickly *at any time*. They cannot exclude the possibility of nuclear use on D-Day, nor the possibility that nuclear weapons will never be used in the entire campaign. These, then, are examples of scheduled and unscheduled adaptations. One of the most deplorable features of Western military planning is its chronic failure to systematically plan for both types of adaptations. By no means does this require rigid and ultimately unrealistic fine-tuned assumptions; instead, it requires: (a) systematically recognizing the possibilities, (b) developing building-block hedges or responses, (c) including some branching structure into basic operations plans, and (d) gaming with enough complexity and reality to develop skills in using the building-block adaptations. Analysts have a somewhat different problem, because the models must make these adaptations automatically, which requires writing decision rules.

The process of writing these decision rules is by far the most complex aspect of the command and control representation. First, the analyst must determine the triggering mechanism for the decision; perhaps the criterion would be rate of advance or perceived enemy strength or some combination of events. Next must be established what information would likely be available in reality and when it would be known. The appropriate information must then be made available to the model at the appropriate time. The actual decision process is then a series of If-Then-Else statements or the more compact version of these, called a decision table. The decision process can consider as many variables and be as complex as time available and the persistence of the analyst permit. In the end, however, the decision will always be based on purely objective data, as there is as yet no way to represent the "feel" of the commander for the battle.

Bounds and Notifications. A particularly important technological feature of RSAS AWPs is that they contain within them the knowledge of when they are failing. The metaphor here is the commander who notifies higher-level authorities that he feels he is unlikely to succeed unless authorized to change strategies or to conduct operations that have previously been denied to him. This is accomplished in the RSAS by identifying classes of problems that may be encountered, developing tests to recognize and measure the seriousness of those problems if they arise, and establishing formatted notifications and requests to higher-level authorities (which may be models or human players). Figure 11 indicates the most important classes of problem. When one of the problems arises, we say a *bound* breaks.

- Escalation or imminent escalation (by the enemy, third parties, one's allies, or unauthorized commanders)
- Alliance problems (one's own or the enemy's)
- Excessive casualties or loss of ground
- Falling excessively behind schedule
- Successes providing new opportunities
- Events suggesting enemy strategy requiring actions not yet authorized or planned
- Tactical warning of nuclear attack

Fig. 11—Generic versions of bounds tested for by AWPs

If a bound breaks and an MCL model notifies higher authorities, perhaps requesting authorization for some contingent action or perhaps recommending a change of strategies, the higher-level authorities (models or humans) may: (a) do nothing, in which case the MCL model must continue, "making do" with its current plan and authorizations; (b) grant authority for contingent actions within the framework of the current AWP; (c) either in addition or instead, take action from their own levels (e.g., launching weapons controlled at their level); or (d) direct a change of strategy and, in RSAS terms, a change in AWP.

In the last case, the next move by the MCL in question will be based on a new AWP that must start operations in a way consistent with the current world state. Thus, the new AWP must be compatible with the old one. To relate this to the real world, suppose that a

NATO Central Region commander had begun combat with a forward-defense strategy and was suddenly told to conduct a defense on the Rhine river instead. He would then have to conduct a large and exceedingly complex fallback involving not just combat units, but support units, supplies, and civilian population.[3]

Building and Modifying Analytic War Plans

Detailed procedures for building and modifying AWPs are given in Schwabe and Wilson (1990). Here our concern is more with the higher-level concepts. Figure 12 summarizes the steps involved in actually developing and using AWPs. The starting point is to conceptualize the strategic issues for the relevant command. For an attacker, the dimensions of strategy include the scope of its aggression, the tradeoff between achieving operational surprise and preparing its own forces, the scheme of maneuver, and responses to the most obvious strategic actions by the defender. During this critical conceptual phase the emphasis must be entirely on military and political-military issues rather than modeling or programming. It is best conducted with a combination of blackboards, maps, and—in some cases—simplified war games such as those sold commercially. A key element of this process is making lists and matrices, with short descriptive labels for many basic concepts. The process is likely to fail if participants insist on dwelling on tactical-level issues (e.g., those with which they were most familiar in their last assignment) or if discussion focuses on models and model limitations. By contrast, if the concepts of operations arising from this step are militarily sound, the likelihood is high that they can be accommodated in the RSAS, although modifications may be necessary.[4]

The second step in building AWPs is more technical and should be conducted by one or a very few people. It is still necessary that military considerations dominate the discussion, but the structure of RSAS AWPs serves to guide discussion by establishing requirements, checklists, and terminology. Some technical jargon slips in here, but it is less serious at this stage.

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[3] Some of the interesting issues of synchronization and how they are dealt with in the RSAS are described in Shlapak, Allen, and Schwabe (1986), based on earlier theoretical work by Davis.

[4] The earliest discussion of many of these issues is in unpublished 1983 work by Davis and Schwabe, which dealt with the concept of "scenario spaces" and "strategy components." One of the most important conclusions from that work was the recognition that the decision models would have to be written with a general class of scenarios in mind, because the alternative was to develop decision rules at a level of abstraction that would make them inappropriate for nearly all practical applications and would also be very hard to fully comprehend. By and large, the existing RSAS AWPs were developed to deal with classic Europe-only, Southwest-Asia only, or global wars involving the superpowers and their alliances.

1. Conceive and name alternative military strategies in general terms.
   a. Characterize the relevant dimensions of strategy.
   b. Define appropriate strategies within those dimensions.
2. Sketch plans for each of the strategies.
   a. Identify and name phases and moves.
   b. Identify key assumptions.
   c. Identify and sketch rules for most important branchpoints that can be scheduled.
   d. Identify and name most important bounds and notifications.
3. Identify, name, and characterize needed order packages.
4. Develop and test building blocks (order packages, move functions, etc.)
5. Develop and test first-cut AWPs in RSAS. Iterate.
6. Enrich AWPs with additional adaptive logic.
7. Assure that AWPs exist to succeed failure of initial AWPs.

Fig. 12—Steps in building AWPs

The remaining steps involve a mix of military thinking, modeling, programming, and simulation (or human war gaming). They are more technical and require more precision. However, the emphasis on modular building-block order packages permits specialization. Thus, in a particular analytic group different people are likely to be knowledgeable about tactical air operations, ground combat operations, strategic mobility, and so on. It is unnecessary for all to be equally facile in all the pieces. There must also be people who understand the RSAS as a whole and can pull things together. In our experience, however, it has proven possible to pull things together technically and make them work (i.e., to perfect the coding and conduct the program verification runs) quickly if only the military concepts and building blocks are cleanly conceived. The limiting factor, by far, has proven to be the "substantive" part of the work. This, of course, depends on having a critical mass of in-house RSAS expertise on the decision models, combat models, and computer-system factors. Organizations that have not made the requisite and significant investment (e.g., two people working for six months mostly on gaining RSAS expertise) have been unable to exploit any but the more superficial aspects of the RSAS.

Status of Military Command Level Models

All of the basic concepts underlying analytic war plans have been successfully embodied in the RSAS and applied successfully in studies. They have proven, as anticipated, to be a powerful organizing device. Further, they have proven relatively straightforward to develop, modify, and use. They have been unequivocally successful in focusing discussion on the strategy variables and encouraging innovative thought about the operational art.

The most extensive and successful applications of AWPs have been concerned with Europe's Central Region, which RAND has studied for some years. For that region we have a significant collection of Red and Blue AWPs representing alternative strategies. Both Red and Blue Agents can not only fight baseline wars in a manner considered to be representative of actual planning, they can also adapt rather well to a variety of developments. Some of this is fully automated and some requires occasional analyst intervention. Further, we have a substantial library of building-block functions that are used routinely in a number of studies, thereby providing a flexibility and efficiency that has been sorely lacking over the years.

Regrettably, the AWPs have by no means been adequately exploited as yet, especially outside RAND (and, within RAND, outside projects involving the Central Region). Most users of the RSAS so far have used them to the extent of having good representations of baseline strategies, which has in itself been very useful for developing joint- and combined-arms concepts of operations and for appreciating Red doctrine. They have not, however, incorporated very much conditional logic nor faced up fully to the implications of planning for massive uncertainty. In some cases users have been less than successful in working with AWPs because they failed to do the necessary homework before plunging ahead at the computer.[5] Ironically, one of the serious adverse aspects of the technological revolution in computer friendliness is a tendency for users to avoid studying what they are working with; instead, they think they can merely sit down and make choices. Although that is altogether feasible for many activities, it is not feasible when attempting to understand and plan seriously for possible wars.

In the years ahead we anticipate that AWP methodology will be more creatively and widely exploited and that it will be considered one of the principal innovations represented

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[5] A chronic problem is the tendency of analysts to undercut RSAS concepts by finding ways to do what they have done in the past faster with the RSAS, rather than to exploit the opportunities to do things differently and better. This is manifested by focusing on the combat models and using scripts of orders rather than full analytic war plans.

by the RSAS. There are encouraging signs of progress: RAND studies that increasingly recognize the importance of adaptive strategies within system analysis of defense-program options; war college activities (classes and war games) in which operational art is emphasized and innovative strategies developed; and a new emphasis on examining diverse scenarios and threats (a consequence of the demise of the Cold War). We also believe that facility in using AWPs as decision aids and building blocks within war gaming will improve substantially in the relatively near future.

III. ILLUSTRATIVE APPLICATIONS FOR EUROPE'S CENTRAL REGION, THEN AND NOW

Until quite recently, the principal military problem facing the United States was defense in Europe's Central Region. Given the fundamental changes that have occurred in Europe and the process of mutual reductions that has begun, this problem is rapidly becoming obsolete. The analysis that has been conducted on the Central Region, however, is an excellent illustration of what can be accomplished more generally with the approach described in this Note.

Dimensions of Strategy

One of the good features about the process of conceiving and building analytic war plans is that one has to identify the dimensions of strategy. For the Pact attacker in a Central Region campaign, some of the main dimensions involved (Davis, 1989):

- Main sectors (number, choices of, force ratios on)
  —Among nominal choices
  —Unconventional choices (flanking operations through a neutral Austria. . .)
- Reserve fraction
- Force ratio on non-main sectors
- Tradeoffs between achieving surprise and one's own preparations; mechanisms for having one's cake and eating it (e.g., premobilization training that arouses suspicions and some reactions, but not cohesive full-scale reactions)
- Options for LOC cutting (special operations, bombing, mining, . . .)
- Air suppression
- Strategy for forcing termination

Some of the instruments available to the Pact included concentration of ground forces, a massive air operation, the use of airborne, heliborne, and other special-operations forces, chemical attacks, and deceptive diplomatic efforts. The use of chemical weapons is yet another important instrument.

For NATO as the defender, some of the key dimensions of strategy involved:

- Force deployments and related command-control structures (e.g., the layer cake)
- Operational strategy (e.g., forward defense versus fallback options)

- Reserve fractions
- Proactive versus reactive approach to the use of reserves
- Counteroffensives
- Preemption
- Interdiction
- Escalation options

To illustrate a few of these, consider Figs. 13 and 14, which show schematically how the Warsaw Pact of years past might have concentrated forces consistent with an attack giving it only a 1.5:1 force ratio initially. Were the Soviets to reinvade Europe in the future, a similar setup might apply, although the figures are merely illustrative. We see that the strategy envisions operational-strategic encirclements after breakthroughs are achieved on the main sectors on which most of the available forces are concentrated. A simple mathematical model of the concentration/counter-concentration process is given in Davis (1989) and Davis, Howe, Kugler, and Wild (1989).

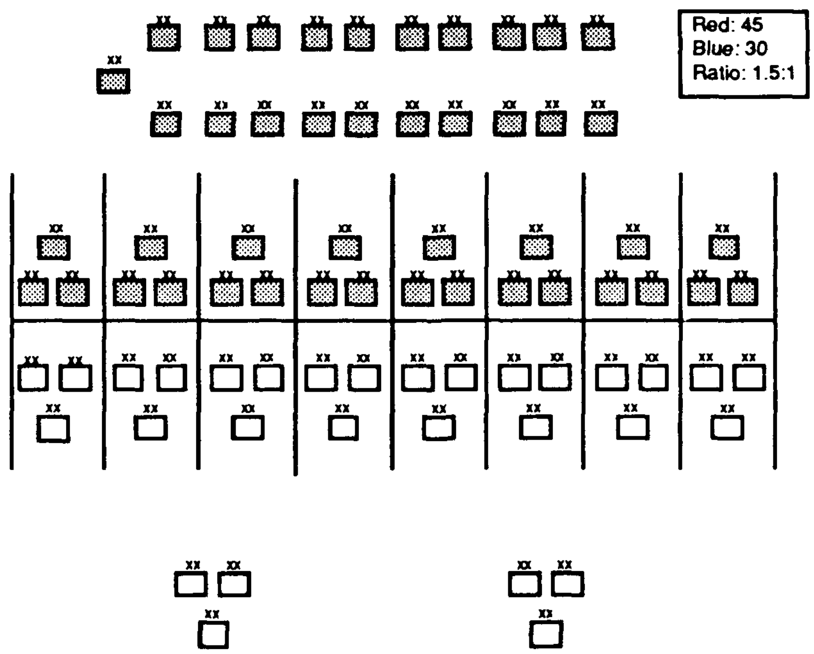

Fig. 13—A notional pre-campaign lineup with an attacker advantage of 1.5:1

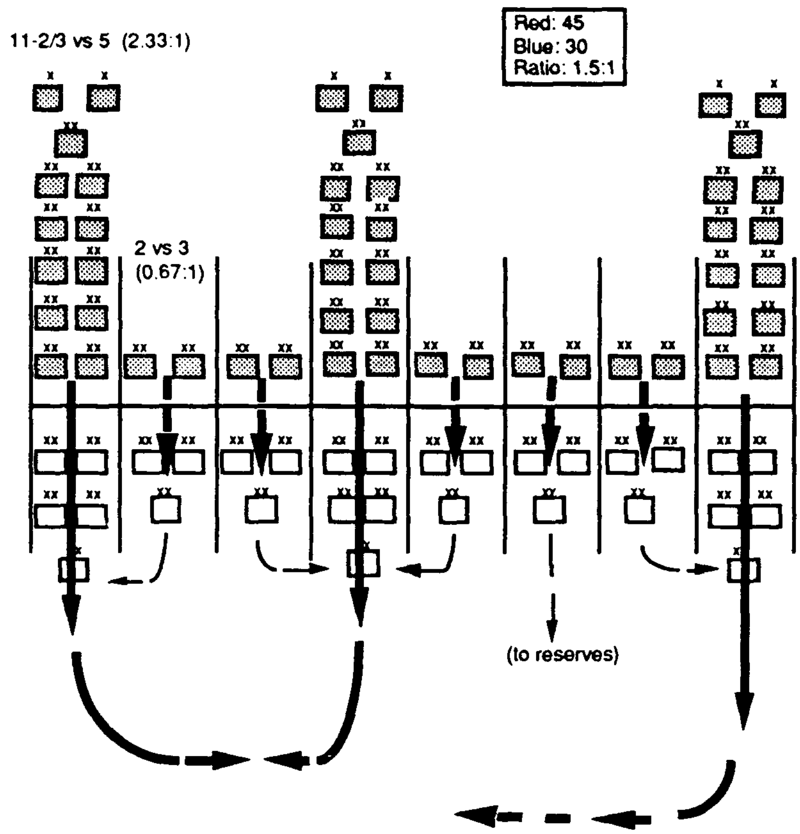

Fig. 14—A planned encirclement operation at the theater level

Figure 15 illustrates a hypothetical situation in Europe following massive reductions to parity. Here the attacker strategy still emphasizes concentration of forces, but the more defense-favorable force ratio makes it much more difficult for the attacker to achieve desired force ratios or multiple main sectors. Because the defender's force posture (a reflection of implicit strategy) is so poor, however, even a glance at the schematic suggests that the attacker may be more successful than he perhaps "should be." The defender is severely maldeployed and has minimal reserves. By contrast, Fig. 16 shows an operational strategy for the defender in which he preferentially defends some sectors, either on the grounds of strategic vulnerability and importance or on the basis of intelligence collection during the attacker's preparation for battle.

Precisely these issues are at the heart of current analysis on such topics as the effects of large-scale reductions on military stability in Europe (putting aside the more dramatic effects on overall stability of Eastern Europe's growing independence). Only a year or so ago,

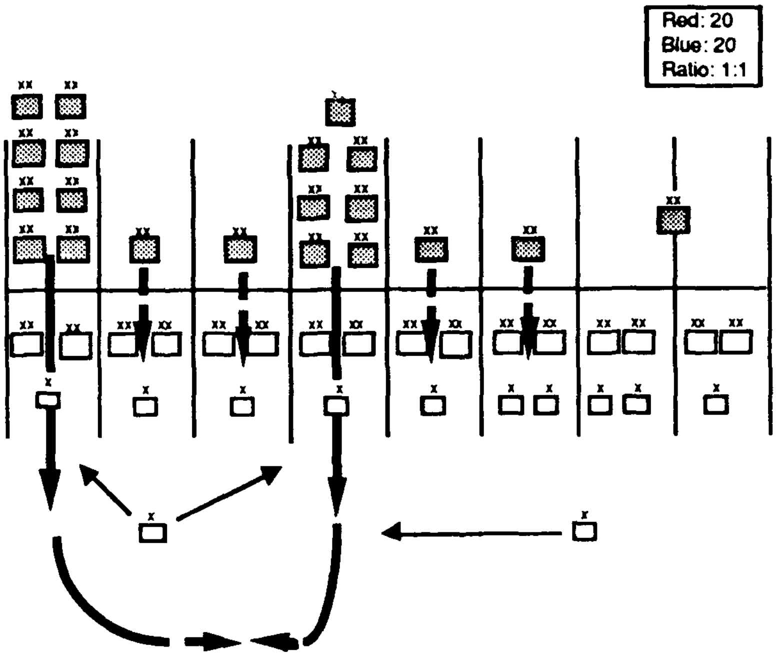

Fig. 15—A poor defender strategy at low force levels and parity

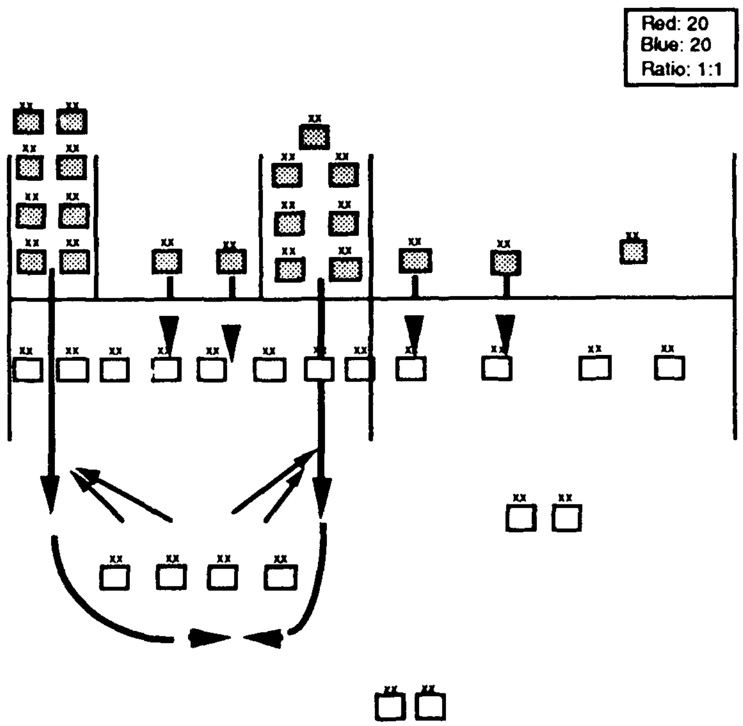

Fig. 16—Preferential defense with a large reserve fraction

analysts and policymakers were concerned about an "operational minimum" below which defense levels could not be allowed to fall because of force-to-space ratio concerns. Today, we recognize that there is no real operational minimum, but we know that the defender's prospects at low force levels would be highly sensitive to issues of strategy. Figure 17 illustrates this for hypothetical Central Region conflicts in which both sides have 18 equivalent divisions each, but the defender adopts quite different strategies from case to case.[1] Following the classic version of forward defense, the defender suffers a sudden and catastrophic defeat. In the other cases, which involve either contingent forward defense that allows selected fallbacks to defensible lines if necessary or proactive reinforcement of weak sectors on the basis of judgment and early intelligence indicators, the defense holds very well indeed—especially if the defender has prepared defenses on D-Day.

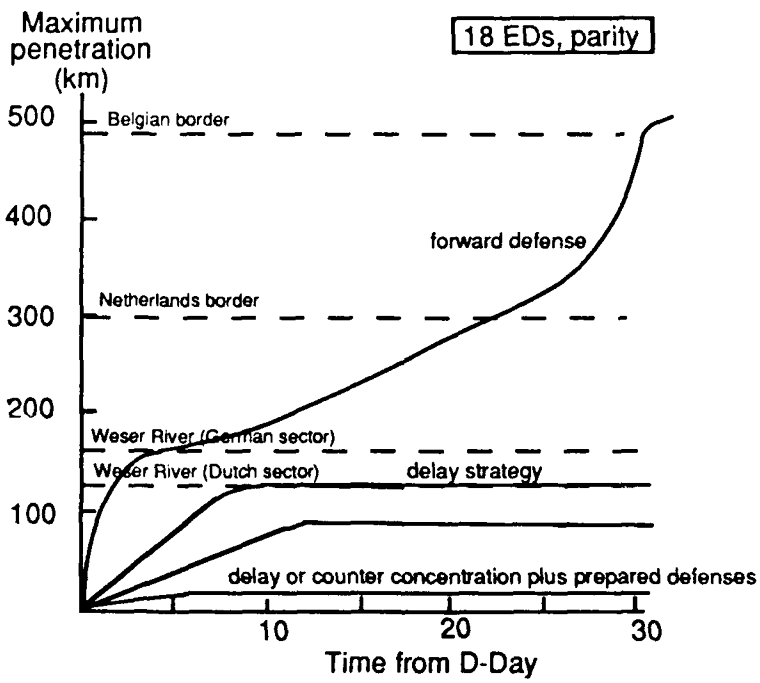

Fig. 17—Illustrative simulation results as a function of defender strategy

These, then, illustrate at a simple level some of the many strategy issues that must be considered to analyze current defense issues involving conventional arms control and NATO's future defense options. Such a strategy-sensitive study must, of course, be in addition to analysis that looks at weapon and force tradeoffs and at force levels per se.

[1] All analytic results are taken from Davis, Howe, Kugler, and Wild (1989) and Davis (1989).

Further, in practice our assessment must be much more complex because of the complications added by multiple nationalities, combined-arms processes, the effects of terrain and prepared defenses, and so on. In our experience, however, the process of using analytic war plans to represent strategies has added substantially to the quality, depth, coherence, and efficiency of our work.

IV. CONCLUSION

Throughout history, the strategies of the opposing sides have had, within limits, a far greater influence on the outcome of battles and wars than has the simple balance of weapons involved. However, military simulation, particularly as practiced in the West, has tended to focus in increasing detail on the interaction of weapons and to treat strategy and command-control as exogenous variables. The RAND Strategy Assessment System (RSAS) was designed in part to assure explicit representation of both. The effort has been highly successful in this regard, and we now have well-understood methods for developing and testing alternative strategies, which can then be recorded and used in subsequent studies and games. There is no longer any excuse for studies to be based on "scripted" force employment.

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